Lessons Learned in Quantification of Dredge Volumes

Quick Personal Bio

• Live in Green Bay, Wisconsin

• Licensed P.E.

• Certified Hydrographer #258: American Congress on Surveying and Mapping (ACSM), merged into National Society of Professional Surveyors (NSPS)

• Performed 200+ hydrographic surveys

• 15+ years of waterfront/marine design and survey experience
Transcontinental Connections
(Union Pacific Causeway, Great Salt Lake, Utah)
• Pre-dredge “Before” Survey A
• Post-dredge “After” Survey B
• Always = the same Cubic Yardage, right?
• Let’s review some basic aspects of surveys and how they impact your dredge payment volume.
• Planning and Bidding
• Execution: Dredging and Disposal
• Completion: Post-process and Payment
Planning and Bidding
Planning and Bidding
Essential #1: Know your specification

- Unit of Measurement
- CDF/Landfill Fees and Requirements
- Dewatering/Discharge Permits
Planning and Bidding

Essential #2: Confirm Project Geometric Dimensions

- Required Depth and Slopes, or
- Limits of Dredging and Slopes Defined
- Pre-dredge Survey must extend beyond future dredge limits
There are 124 different State Plane coordinate systems defined.
Planning and Bidding

Essential #4: Confirm Distance Units

U.S. Feet
636,320.57' N
26,906,602.26' E

International Feet
636,321.85' N
26,906,656.07' E

1 intl foot = 0.99999803149994 U.S. Survey feet
Essential #5: Confirm Vertical Datum

- National Geodetic Vertical Datum of 1929 (NGVD29)
- North American Vertical Datum of 1988 (NAVD88)
- Mean Sea Level (MSL)
- International Great Lakes Datum of 1988 (IGLD88)
- Low Water Datum (LWD)
Essential #6: Confirm Existing Benchmarks

Where are they?

The plane of existing low water datum as used in these specifications is that determined by the following benchmarks:

A. C 471 (PI D No 00865), ELEVATION - 580.93 (feet), in Barcelona, along First Street, on the property of the Barcelona Harbor House restaurant, 12.80 meters (42.0 ft) northwest of the center of First Street, 3.90 meters (12.7 ft) north of the east corner of the restaurant, 2.13 meters (7.0 ft) southeast of the southeast face of the building. The mark is above level with street.

B. EAST (PI D No 00884), ELEVATION - 575.10 (feet) - In Barcelona, at the northeast corner of the city pier at the Barcelona Harbor, 1.40 meters (4.7 ft) south of the north edge of the pier, 1.40 meters (4.6 ft) west of the east edge of the pier. The mark is above level with pier.

C. BARCELONA ECO (PI D No 00845), ELEVATION - 978.14 (feet), In Barcelona, at the northeast corner of the city pier, at the Barcelona Harbor, 0.97 meter (3.2 ft) south of the north edge of the pier, 1.16 meters (3.8 ft) west of the east edge of the pier. The mark is a standard brass disk above level with pier.

D. 906 3063 MONROE & BURLS (PI D No 00887), ELEVATION 586.92 (feet) In Barcelona, set vertically in the block building (covered with a wood siding) of the Westfield Fisheries, 825 1st St. Westfield, NY 14787, 0.18 meter (0.6 ft) northeast of the east corner of the building. The mark is 1.20 M above ground. There is a cut out circle that can be removed at time of need.

The plane of low water datum is 59.2 feet above mean level at Rimouski, Quebec (IHO, 1955). (International Great Lakes Datum 1955).
Planning and Bidding

Essential #7: Confirm Over-Depth or Over-Dredge Allowance

- Channel
- Sideslopes
- Required or optional

![Diagram showing typical submerged section](image-url)
Planning and Bidding

Essential #8: Confirm Allowable Method of Dewatering

- Navigational projects
- Environmental projects
- Sealed Barge or Drain off barge allowed
- Pre-discharge treatment
Planning and Bidding

Essential #9: Confirm if Hard Material Removal is Required

- Is hard material defined? How?
- Separate pay rate?
- Who determines quantity? Contractor or Engineer?
Execution: Dredging and Disposal Phase
Execution: Dredging and Disposal

Essential #10: Confirm Specification of Pre-dredge Survey

Who performs?
When can it be performed?
Timing of approval
Handling of volume changes

1.3.4 Quantity Determination

Before and After dredge surveys shall be performed by the Government for purposes of acceptance and determination of quantities dredged. The Government will conduct surveys in accordance with EM 1110-2-1003, "Hydrographic Surveying", using one of the following methods: (1) multibeam, (2) single beam, or (3) lead line, whichever is deemed appropriate by the Government for the harbor/channel being dredged. The quantity calculation method utilized will be in HYPACK software utilizing either the TIN method or the Standard HYPACK method. The surveying method and quantity calculation method utilized will be determined solely by the Government and is entirely at its discretion. Upon request, the Contractor will be advised of the surveying method and quantity calculation methods to be used prior to the commencement of dredging.
Essential #11: Confirm if Heave-Pitch-Roll Sensor Required

Or perform during calm seas
Execution: Dredging and Disposal

Essential #12: Equipment Calibration: Sound Velocity

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<th>Temperature (°F)</th>
<th>Speed of Sound (ft/s)</th>
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</table>

- Acoustic velocimeter
- Water temperature
- Barometric pressure
- Salinity
Execution: Dredging and Disposal

Essential #13: Equipment Calibration: Bar Check

- Deep Bar
- Shallow Bar
- Index Constant
- Draft
Essential #14: Determine Dynamic Draft

- Bar Check while dead in water
- Level from shore
- Pressure transducer
- Drift then Motor

Squat/Settlement: Required to compensate for differential displacement at varied speeds. (Less-so for RTK Tides)
Execution: Dredging and Disposal

Essential #15: Tide Recording

- Staff gage near project
- Frequency of measurement
- Tide Recording: Establish frequency of Tide/Stage/Water Level Records – Check against vertical control
Execution: Dredging and Disposal

Essential #16: DGPS or RTK Position Latency

- Survey lines both directions over steep slope
- Symptom: Sawtooth contours
Essential #17: Quality Assurance

- Quality Assurance (Proactive)
  - Focus on Process
  - Different surveys by different vessels
  - Cross-Line Checks
  - Establish Check-Line Control Section outside project limits
  - Extend Cross Sections to undisturbed areas
  - Check for lack of repeatability
  - Identify biases
  - Check Statistical Differences
Completion: Post-Process and Payment Phase
Execution: Dredging and Disposal

Essential #18: Confirm method of volume computation (or eligible alternatives)

- Read Specification Closely
- Two main methods:
  - Average End Area (AEA) or derivatives thereof
  - Triangulated Irregular Network (TIN)
Thank You!

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